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Can end

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The present invention relates to a pressurised can and in particular, to an end suitable for use on a pressurised food can. In a pressurised food can, the food product is inserted into the can and stored therein under pressure. The increased pressure in the can is achieved by pressurising the headspace above the food product.

This may be achieved in a number of different ways. For example, a droplet of liquid, inert gas may be inserted into the can prior to sealing, as described in Patent No. US 2,894,844. The liquid then evaporates and the resultant gas pressurises the headspace. Alternatively, after sealing, a portion of the can may be irreversibly pushed inwardly to similarly pressurise the headspace gases by forced reduction of the volume of the headspace. This technique is described in European Patent No. EP 0 521 642.

The advantage of pressurising a food can is that the can may be made of substantially thinner gauge metal, which is deformable under normal conditions. However, the internal pressure in a pressurised food can, supports the walls of the can, providing the rigidity, which is required for handling and transport of the can.

However, a food can, whose contents are held under pressure, has the disadvantage that upon first opening, the pressure inside the can is rapidly released to atmosphere and the stream of released gases may carry a quantity of food product. This problem is referred to as "spurting" and is highly undesirable for the consumer. In

extreme circumstances, such "spurting" may have explosive force making the can dangerous. The present invention is concerned with mitigating or even eradicating "spurting", upon first opening of a pressurised food can.

5 Preferably, the volume of the headspace (the gap between the surface of the product and the end used to seal the can) is minimised. This reduces the volume of pressurised gas released from the can upon first opening. However, according to the invention, the height of the
10 headspace is maximised at the point at which the can is first pierced and the pressure released. The height of the headspace at this point of first opening has been found to be critical in determining whether the can will "spurt" on first opening.

15 Conventionally, food cans comprise a body, in which the product is stored and at least one end, which is connected to the free edge of the body, conventionally by seaming and in particular by a technique known as double seaming. Conventional ends comprise a flat plate-like
20 centre panel connected to a seaming portion (often referred to as the "cover hook") via a chuck wall, which supports a seaming chuck during the double seaming process. At the base of the chuck wall a concave reinforcing bead (looking from the outside of the can) is
25 normally provided, to strengthen the end and support the seam. Conventional can openers first pierce the can at a point adjacent to or lying within the reinforcing bead. Further shallow beads may also be provided on the wall of the can body and/or on the end, to strengthen the can.

Accordingly the invention provides a pressurised can comprising a sealed vessel having an access region and a product confined within the sealed vessel and defining a free surface adjacent to a pressurised headspace, which is arranged in communication with the access region, characterised in that the vessel is designed to minimise the volume of the headspace, whilst maximising the height of the headspace above the product surface at the access region.

According to the prior art the headspace in the can should be minimised. This is true in most conventional food cans, as any volume in the can not used for the product is wasteful and poorly conceived by consumers. In a pressurised food can, the volume of the headspace is particularly important, because this "space" contains the pressurised gas used to pressurise the headspace. Thus, a large headspace volume results in a large volume of pressurised gas that has to be released into the atmosphere. However, the inventor has found that the height of the headspace at the point of first opening is particularly important to the spurting properties of the can and should be maximised to reduce the risk of unacceptable spurting. Thus, the design of the can will involve a trade-off between minimising the volume of the headspace for the reasons discussed above and maximising the vertical distance between the surface of the product and the point of first opening of the can, to reduce the chances / level of spurting. This may be achieved by

increasing the height of the headspace within the access region, but reducing the height of the headspace between the surface of the product and the area of the end outside the access region.

5 Thus, where a can is opened using a conventional can opener or where the can end is a so-called "easy-open end" (eg. EOLE®) and is therefore opened towards the peripheral edge of the can end, the central portion of the end may be indented so that it lies closely adjacent
10 to or even touching the surface of the product. This allows the headspace volume to be minimised whilst allowing the height of the headspace at the point of first opening to be sufficiently large to prevent or at least reduce the level of spurting.

15 A number of tests were carried out using cans, having two different types of end (EOLE - Easy Open End and NEO - Non-easy Open End), different levels of headspace pressurisation and a height of headspace at the point of first opening of 8mm. A headspace height of 8mm
20 was chosen as a good average of the headspace height allowed in most conventional food cans. All cans were tested at ambient temperature (25 °C), allowed to stand for at least ½ hour before opening and NEO samples were opened using a Standard Butterfly can opener. The level
25 of spurting from the can upon first opening was recorded by holding a sheet of white paper over the end of the can to catch any spatter of food product ejected from the can. This test is referred to as the white glove test (WGT) and the results of the tests are shown in Table 1

(below). The test is intended to represent the degree of "spurting" that a user would experience, if opening the can whilst wearing white gloves. The test is considered successful, if the user could open the can, with no marks
5 damaging the gloves.

TABLE 1

Can	End Type	Pressure psi/(bar)	Headspace Height (mm)	Product	WGT	Comments
1	EOLE	5 (0.34)	8	Water	Fail	Droplets ejected
2	EOLE	5 (0.34)	8	Water	Pass	
3	EOLE	5 (0.34)	8	Water	Pass	
1	EOLE	10 (0.69)	8	Water	Fail	Droplets ejected
2	EOLE	10 (0.69)	8	Water	Fail	Spurt of water
3	EOLE	10 (0.69)	8	Water	Fail	Spurt of water
1	EOLE	15 (1.03)	8	Water	Fail	Big spurt of water
2	EOLE	15 (1.03)	8	Water	Fail	Explosive Opening
3	EOLE	15 (1.03)	8	Water	Fail	Big spurt of water
1	NEO	5 (0.34)	8	Water	Pass	
2	NEO	5 (0.34)	8	Water	Fail	Jet of Water
3	NEO	5 (0.34)	8	Water	Fail	Jet of Water

Can	End Type	Pressure psi/(bar)	Headspace Height (mm)	Product	WGT	Comments
1	NEO	10 (0.69)	8	Water	Pass	
2	NEO	10 (0.69)	8	Water	Fail	Jet of Water
3	NEO	10 (0.69)	8	Water	Fail	Big spurt/Jet
1	NEO	15 (1.03)	8	Water	Pass	
2	NEO	15 (1.03)	8	Water	Fail	Big jet of water
3	NEO	15 (1.03)	8	Water	Fail	Big Jet of Water

The same series of tests were then carried out for a headspace height at point of first opening of 12 mm and
5 headspace pressurisation of 10 psi (0.69 bar) and 15 psi (1.03 bar) - For results, see Table 2.

TABLE 2

Can	End Type	Pressure psi/(bar)	Headspace Height (mm)	Product	WGT	Comments
1	EOLE	10 (0.69)	12	Water	Pass	No spurt/No water
2	EOLE	10 (0.69)	12	Water	Pass	No spurt/No water
3	EOLE	10 (0.69)	12	Water	Pass	No spurt/No water
1	EOLE	15 (1.03)	12	Water	Pass	No spurt/vapour?
2	EOLE	15 (1.03)	12	Water	Fail	water ejected
3	EOLE	15 (1.03)	12	Water	Pass	No spurt/No water

Can	End Type	Pressure psi/(bar)	Headspace Height (mm)	Product	WGT	Comments
1	NEO	10 (0.69)	12	Water	Pass	No spurt/droplets on end
2	NEO	10 (0.69)	12	Water	Pass	No spurt/droplets on end
3	NEO	10 (0.69)	12	Water	Pass	No spurt/droplets on end
1	NEO	15 (1.03)	12	Water	Pass	No spurt/droplets on end
2	NEO	15 (1.03)	12	Water	Pass	No spurt/droplets on end
3	NEO	15 (1.03)	12	Water	Pass	No spurt/droplets on end

By comparison of the results from Tables 1 and 2 above, it can be seen that a headspace height of 12 mm at the access region / point of first opening significantly reduces the spurting for both EOLE and NEO ends. As expected, lower pressurisation of the headspace results in lower levels of spurting.

This theory works well for liquid products (i.e. water) or products held in a liquid (vegetables in brine, for example), but further problems have been identified with more viscous products (chilli con carne and pet food, for example). When these products are agitated during transport, handling etc. or stored in an inverted position, it takes longer for the product to resume its original surface and in some cases this may never occur. In these circumstances, it is likely that at least some product will be retained within the area having the larger headspace height, at the point of first opening. Consequently containers filled with such viscous

products, have been found to spurt upon first opening of the container, despite the can having a maximised headspace height at this point.

In order to gain a better understanding of this phenomenon, a transparent can was filled with various products, to observe the effect of opening. The surface tension of thicker products was observed to cause the product surface to creep up the sidewall of the can, reducing the overall headspace height at the point of first opening.

However, the same surface tension forces of these thicker products can also be used to mitigate this problem, by the careful placement of attraction features within the headspace but outside the access region. If an indentation is provided extending into the headspace of the can, such that it touches or approaches close to the surface of the product, such products will tend to be attracted to the indentation, which then acts as an attraction feature and draws the product away from the access region, leaving the height of the headspace at the point of first opening largely unobstructed.

Furthermore, the meniscus formed on the surface of a the product has been found to make a "meniscus jump" to such attraction features, even when they are not in contact with the product surface. Thus, the attraction feature still acts to draw product away from the required headspace height around the access region. The viscosity and composition of the product will determine the size of gap between the product surface and the attraction

feature and therefore the size of "meniscus jump" that the product surface will make.

The invention will now be described, by way of example only, with reference to the accompanying
5 drawings, in which:

FIGURE 1 shows a conventional food can with a non-easy open end (NOE), identifying the height of the headspace (h) at the point of first opening, using conventional can openers.

10 FIGURE 2 shows a food can according to the invention having an attraction feature, which touches the surface of the product.

FIGURE 3 shows an alternative embodiment according to the invention having an attraction feature, which is
15 designed to approach but not touch the surface of the product, illustrating the "meniscus jump" phenomenon.

FIGURE 4 shows a further embodiment according to the invention having an end with a stepped configuration, designed to provide improved strength.

20

For ease of reference, like features are designated using the same reference numerals throughout the drawings.

Referring to Figure 1, conventional food cans have a
25 body 2 and at least one end 3, which is connected to the open end of the body 2 by a seam 4, normally a double seam. The food can 1 may either take the form of a 2-piece can, in which the body 2 is produced as a base end and integral side wall or, a 3 piece can, in which the

side wall takes the form of an open cylinder and separate ends are then seamed on to both ends of the cylindrical side wall. A base end is seamed to one of the open ends of the cylinder prior to filling with product 5 and
5 thereafter the second, top end is seamed on to the other end of the cylindrical sidewall.

The body 2 (comprising the sidewall and base) is filled with a product 5 to a predetermined fill height. Where the product 5 is a liquid, the product surface 55
10 will form a meniscus, which is substantially flat. Due to surface tension effects, the product surface 55 will tend to creep up the sidewall of the can 1 to a point 52, wherever the product surface 55 adjoins the body 2. The free space between the product surface 55 and the end 3
15 is referred to as the headspace 7 and is filled with gas (normally air or an inert gas). In a pressurised food can, it is this headspace 7 which is pressurised.

Now concentrating on the top end 3 of the can, the periphery of which is wrapped into the double seam 4
20 together with the open end of the body 2. Positioned radially inwardly of the seam 4, the end 3 has an inwardly concave reinforcing bead 6, which provides strength to the end 3. Conventional tin openers pierce the can 1 either at the base of the reinforcing bead 6 of
25 the end 3 or at the base of the seam 4 through the sidewall of the body 2.

Considering a conventional tin opener which first pierces the can at the base of the reinforcing bead 6, the teaching of the invention shows that the headspace

height h between the point of first opening (i.e. the point at which the tin opener first pierces the can) and the product surface 55 needs to be as large as possible, if "spurting" is to be avoided. However, it is also known
5 that a large headspace volume is undesirable in a pressurised food can because a large headspace volume necessitates venting of a larger volume of gas before the pressure in the can reaches atmospheric pressure. A large headspace 7 is also perceived badly by consumers, who
10 feel cheated by the fact that the can 1 is not as full as originally perceived. Thus, a compromise has to be reached between maximising the height, h , of the headspace 7, whilst controlling the overall headspace volume.

15 Referring now to figure 2, a food can 1 according to the invention may have the same body 2, end 3, seam 4 and reinforcing bead 6 configuration described above. However, the can 1 is additionally provided with one or more attraction features 11, which draw the product 5
20 away from the point of first opening (at the base of the reinforcing bead 6), thereby maintaining a clear headspace height h at this point. The attraction feature 11 comprises an indented feature (looking from the outside of the can), which is sized and positioned such
25 that it touches the surface 55 of the product 5. The product surface 55 is attracted to the attraction feature 11, by surface tension forces, thereby forming a meniscus with attraction points 51 and 52. Thus, product 5 is drawn away from the point at which the can is first

pierced (at the base of the reinforcing bead 6). The indentation (attraction feature 11) also has the benefit that it reduces the overall volume of the headspace 7, reducing the volume of pressurised gas that is vented when the can 1 is first opened.

Figure 3 illustrates another embodiment of the invention, to which the principle of an attraction feature 11 has been applied. The food can 1 comprises a body 2, to which an end 3 is sealed by a double seam 4. As previously described the can has a reinforcing bead 6 and many conventional designs of tin opener are designed to first pierce the food can 1 at the base of this bead 6. The can 1 is filled with a product 5 to a predetermined height. A portion of the can end 3, spaced radially inwardly of the reinforcing bead 6 is indented inwardly by a distance sufficient to approach closely but not touch the surface of the product 5. In this embodiment, the attraction feature 11 does not touch the surface 55 of the product 5, but approaches sufficiently closely that the attraction of the product surface 55 to the attraction feature 11 causes the product surface 55 to make a "meniscus jump" 50, bridging the gap between the product surface 55 and the lowest point of the attraction feature 11. This meniscus jump 50 obviously draws an even greater volume of product 5 away from the point of first opening 6, ensuring the headspace 7 is unobstructed at this point.

Figure 4 illustrates yet another embodiment of a pressurised food can 1 to which this principle has been

applied. The food can 1 comprises a body 2, to which an end 3 is sealed by a double seam 4. Again the end has a reinforcing bead 6 and an indentation spaced radially inwardly thereof, which acts as an attraction feature 11.

5 In this embodiment, the indentation feature 11 is indented by means of a series of steps, designed to approximate the shape of a curve C. It is known from the manufacture of pressure vessels that a domed shape (either concave or convex) has the greatest strength in
10 resisting pressure. Formation of a stable dome is difficult when using thin metal (as is the case in the manufacture of food cans). However, technology already exists for providing complex bead profiles in can ends and this technology can be applied to produce an end 3
15 having a profile shown in Figure 4. By adapting the shape and position of the steps, the indentation produced in the can end 3 can be made to follow the curve C, giving the end 3 some of the strength benefits of a domed end, whilst being easier and cheaper to produce from
20 relatively thin metal at high speed.

CLAIMS

1. A pressurised can (1) comprising
 - a sealed vessel (2, 3) having an access region (6), and
 - a product (5), confined within the sealed vessel (2,3), and defining a free surface (55) adjacent to a pressurised headspace (7), which is arranged in communication with the access region (6), characterised in that
 - the sealed vessel (2,3) is designed to minimise the volume of the headspace (7), whilst
 - maximising the height (h) of the headspace above the product surface (55) at the access region (6).
2. A pressurised can (1) according to claim 1, wherein the sealed vessel (2, 3) comprises
 - a body (2) having an opening and
 - a cover (3) arranged to cover and seal the opening.
3. A pressurised can (1) according to claim 2, wherein the body (2) is a cylindrical food can having an open end and the cover (3) is a food can end, which is connected to the open end of the body (2) by a seam (5).
4. A pressurised can (1) according to claim 3, wherein the food can end (3) is an easy open end having a tab designed to activate rupture of a score and the

access region (6) is defined surrounding the point at which the score is designed to first rupture.

5. A pressurised can (1) according to any one of claims 2 to 4, wherein the access region (6) is defined by the cover (3).
6. A pressurised can (1) according to any of the preceding claims, wherein the access region (6) is spaced from the interface between the body (2) and the cover (3).
7. A pressurised can (1) according to any of the preceding claims, wherein the sealed vessel (2, 3) has at least one attraction feature (11), which extends into the headspace (7) to a point approaching or in contact with the free surface (55) of the product (5) wherein the attraction feature (11) is spaced from the access region (6).
8. A pressurised can according to claim 5, wherein the attraction feature (11) takes the form of an inwardly concave section of the sealed vessel (2, 3).
9. A method of manufacture of a pressurised can (1) according to any one of the preceding claims, comprising the steps of
 - taking a vessel (2) having an opening,
 - filling the vessel (2) with a product (5) through the opening such that the product (5) defines a free surface (55), whilst leaving a space inside

the vessel (2) above the free surface (55),
- inserting a small droplet of a liquid inert gas
onto the free surface (55) and
- sealing the vessel by plugging the opening,
wherein
- the space above the free surface defines a
headspace (7) and the liquid inert gas evaporates
to pressurise the headspace.

ABSTRACT

A pressurised can (1) having a body (2) with an open end, through which a product (5) is inserted into the can, and a cover (3) arranged to cover and seal the open end. The can is filled to a predetermined height such that the cover (3) is spaced from the product surface (55) to leave a headspace (7). The can (1) is adapted to minimise the volume of the headspace (7), whilst maximising the height (h) of the headspace (7) at the point at which the can (1) is first opened.

(Fig 2)

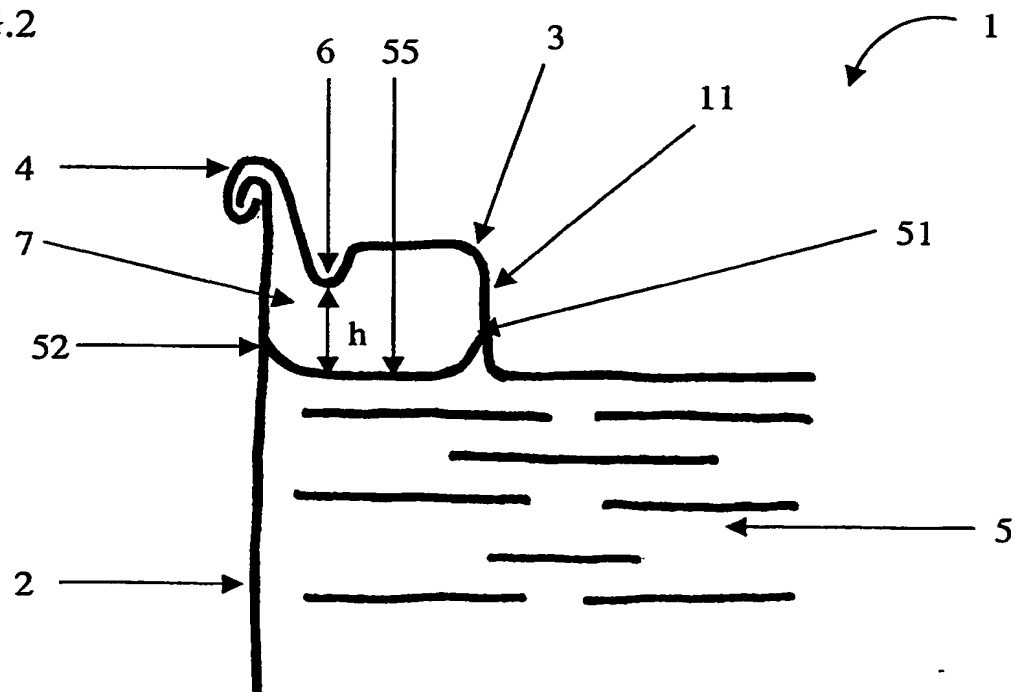


Fig. 3

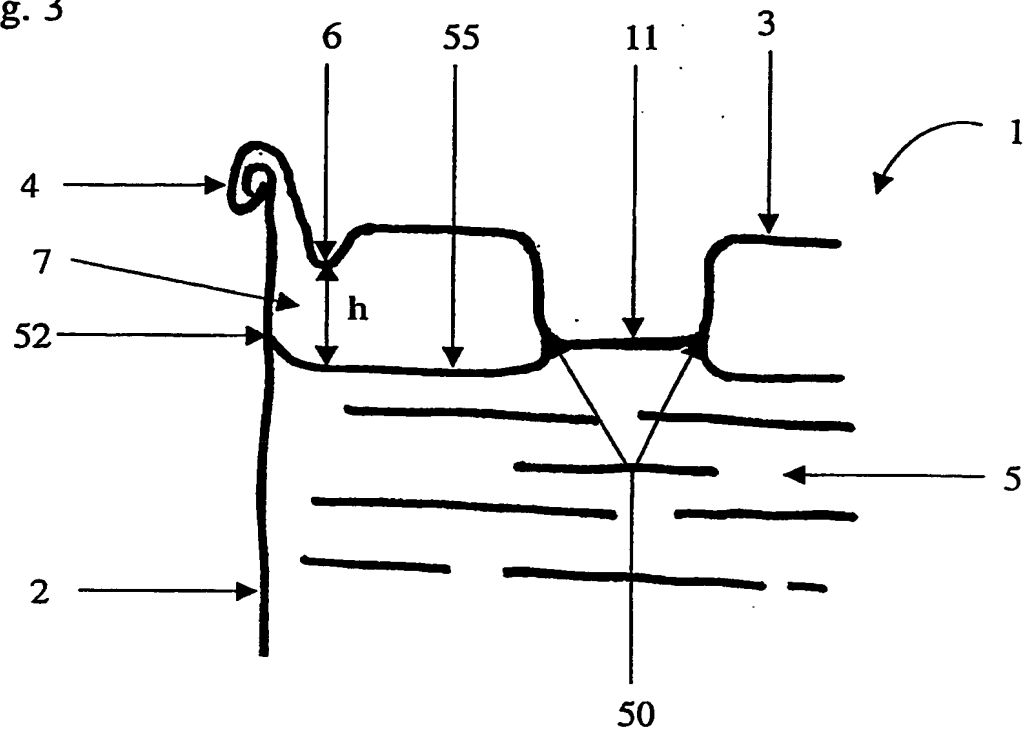
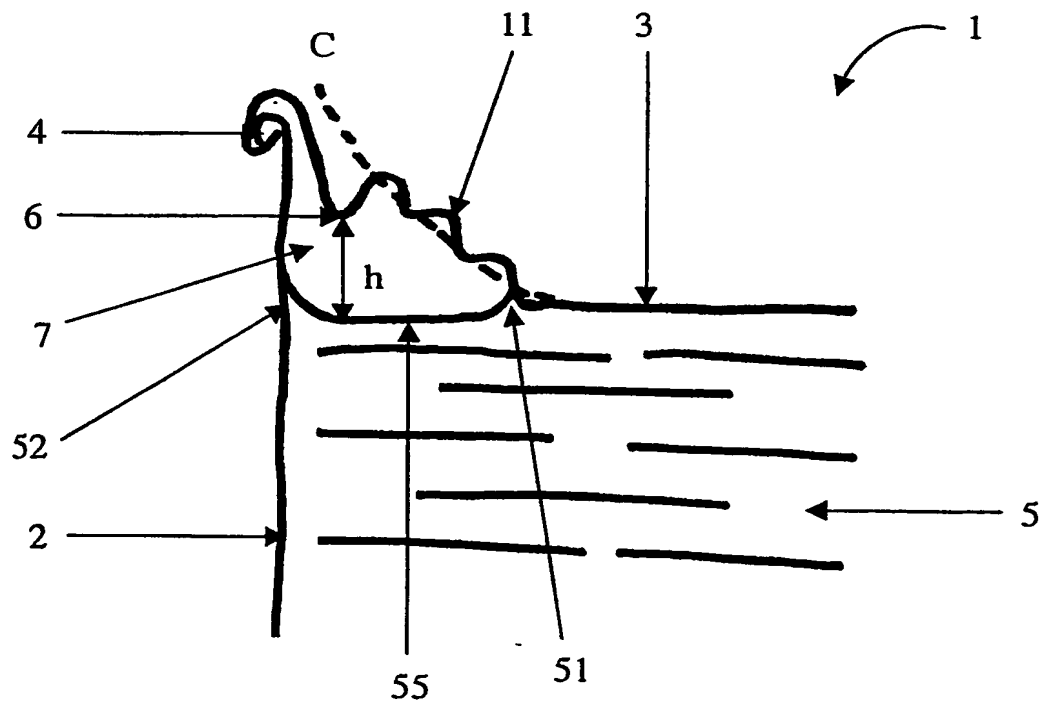


Fig. 4



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